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(54) **MOVEMENT UNIT**

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CPC ***F16M 13/022*** (2013.01); ***B64D 11/00*** (2013.01); ***F16C 29/004*** (2013.01); ***F16C 29/008*** (2013.01); ***F16C 29/0623*** (2013.01); ***F16M 13/027*** (2013.01); *B64D 2231/025* (2013.01); *F16C 29/063* (2013.01); *F16C 2326/43* (2013.01)

(58) **Field of Classification Search**
USPC 248/424, 429, 220.21, 220.22, 223.41, 248/224.51, 224.61, 225.11
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,373,635 A 12/1994 Nonaka et al.
6,049,988 A * 4/2000 Shirai ..... F16C 23/06 33/1 M

(Continued)

FOREIGN PATENT DOCUMENTS

JP 62-56660 A 3/1987
JP 2-93117 A 4/1990

(Continued)

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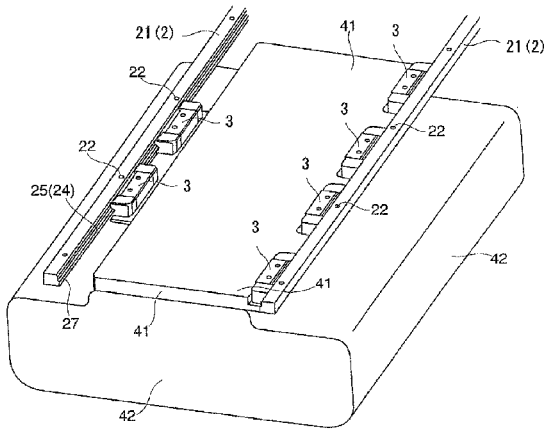
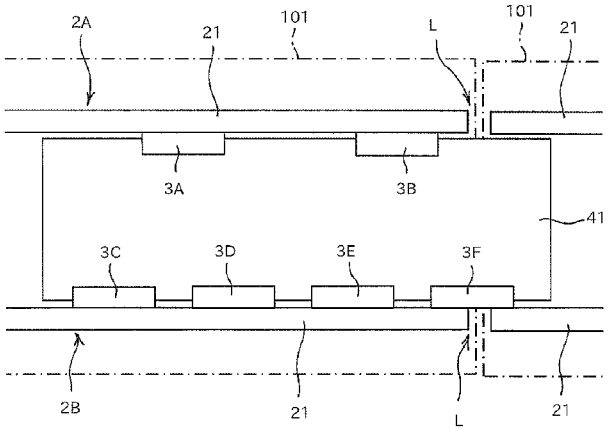
(57) **ABSTRACT**

Provided is a moving unit that enables a movable body to be smoothly moved along guide tracks for guiding the movable body across joints between a plurality of track rails arranged in series so as to serve as the guide tracks. The moving unit includes: the pair of guide tracks laid in parallel to each other; a plurality of moving blocks being two or more moving blocks assembled to each of the guide tracks and being freely movable along the guide tracks; and the movable body fixed to the moving blocks. The track rails arranged in series serve as the guide tracks, and each have a guide surface formed along a longitudinal direction of each of the track rails. The moving blocks each include contact elements configured to travel on the guide surface while passing across joint clearances each being formed between the track rails arranged in series.

4 Claims, 9 Drawing Sheets





(51) **Int. Cl.**

F16C 29/00	(2006.01)
B64D 11/00	(2006.01)
F16C 29/06	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,254,047	B1 *	7/2001	Dedrick	B65D 90/006 248/298.1
7,451,955	B2	11/2008	Teramachi et al.	
8,763,978	B2 *	7/2014	Newman	F24J 2/5205 248/424
2010/0124457	A1 *	5/2010	Cook	B60N 2/01558 403/409.1
2014/0131543	A1 *	5/2014	Goto	G10H 1/348 248/429

FOREIGN PATENT DOCUMENTS

JP	5-133416	A	5/1993
JP	7-269569	A	10/1995
WO	2005/031082	A1	4/2005

* cited by examiner

Fig. 1

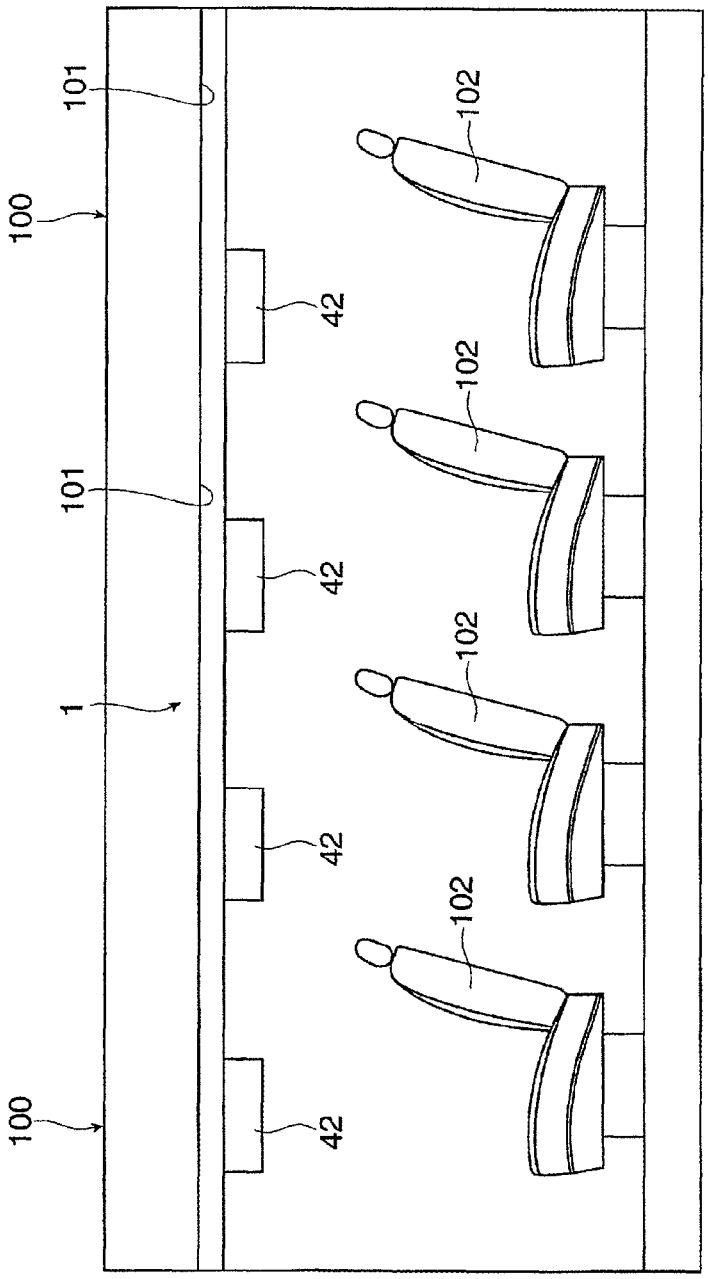


Fig. 2

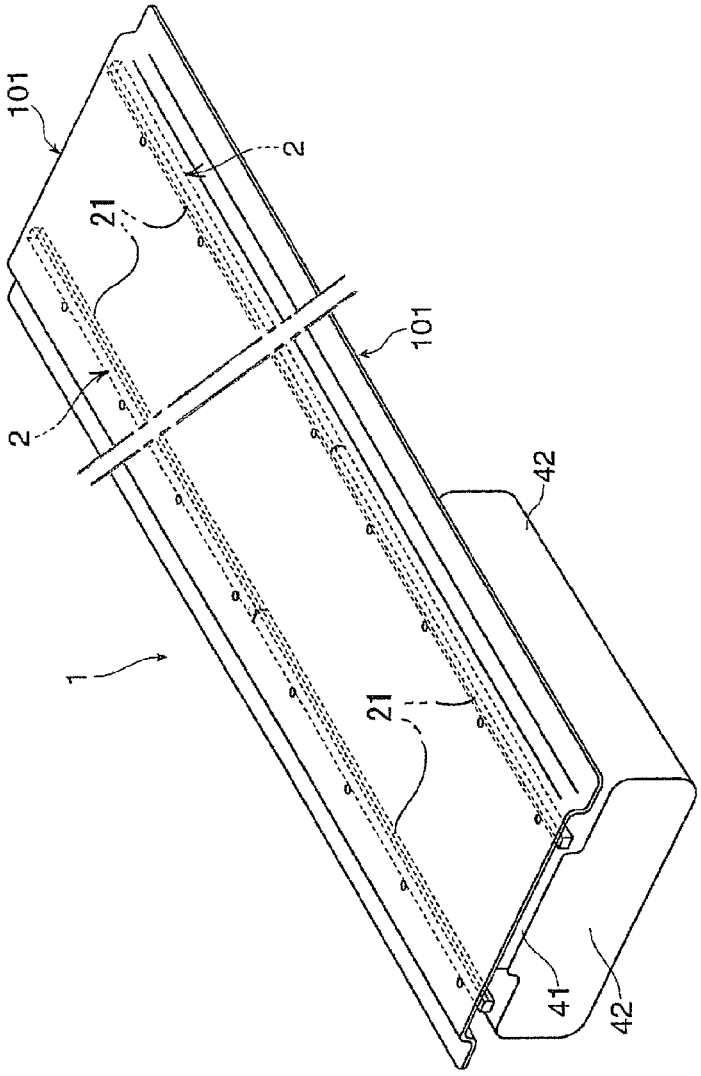


Fig. 3

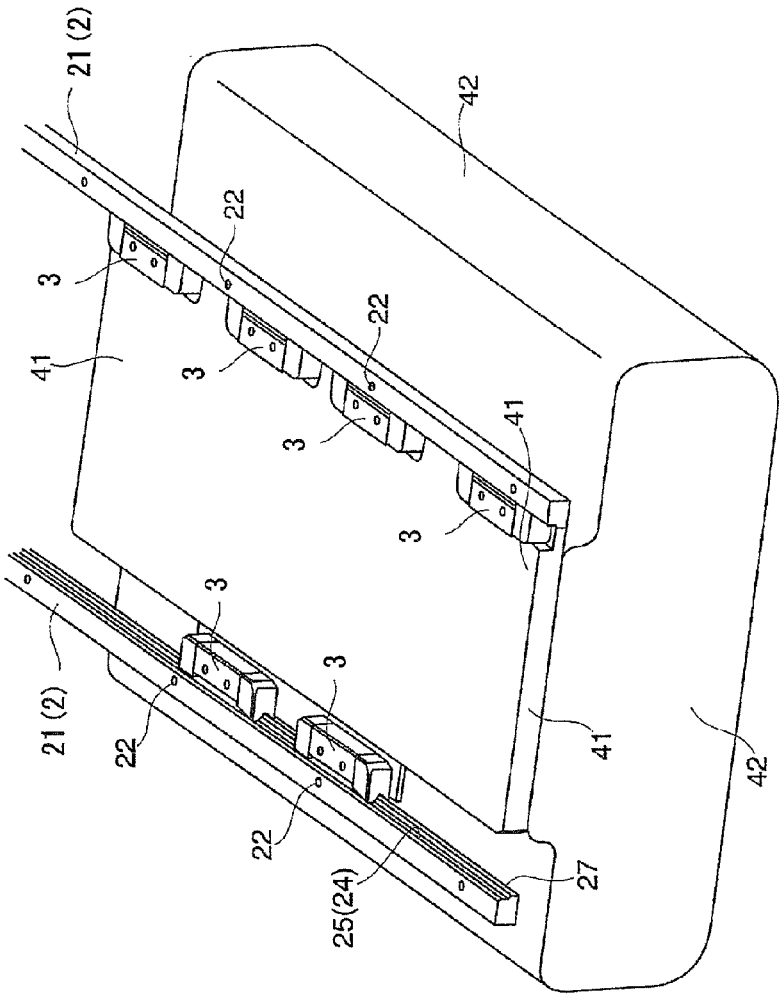


Fig. 4

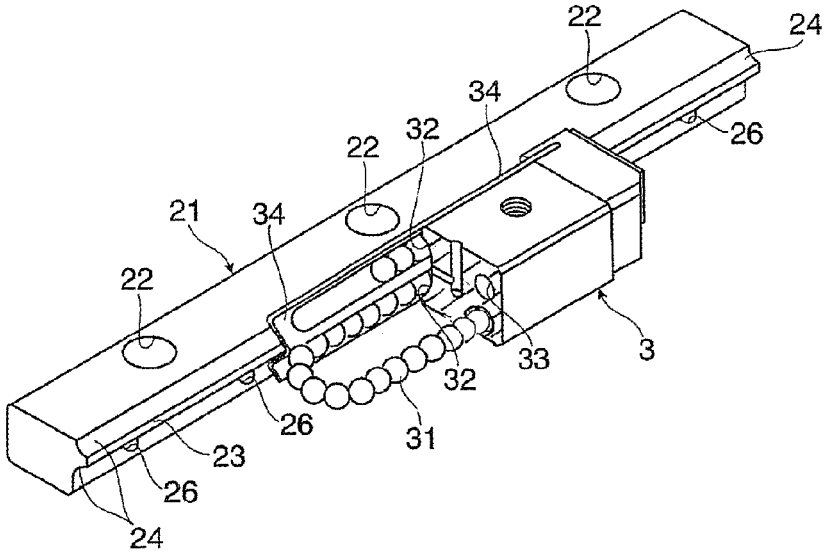


Fig. 5

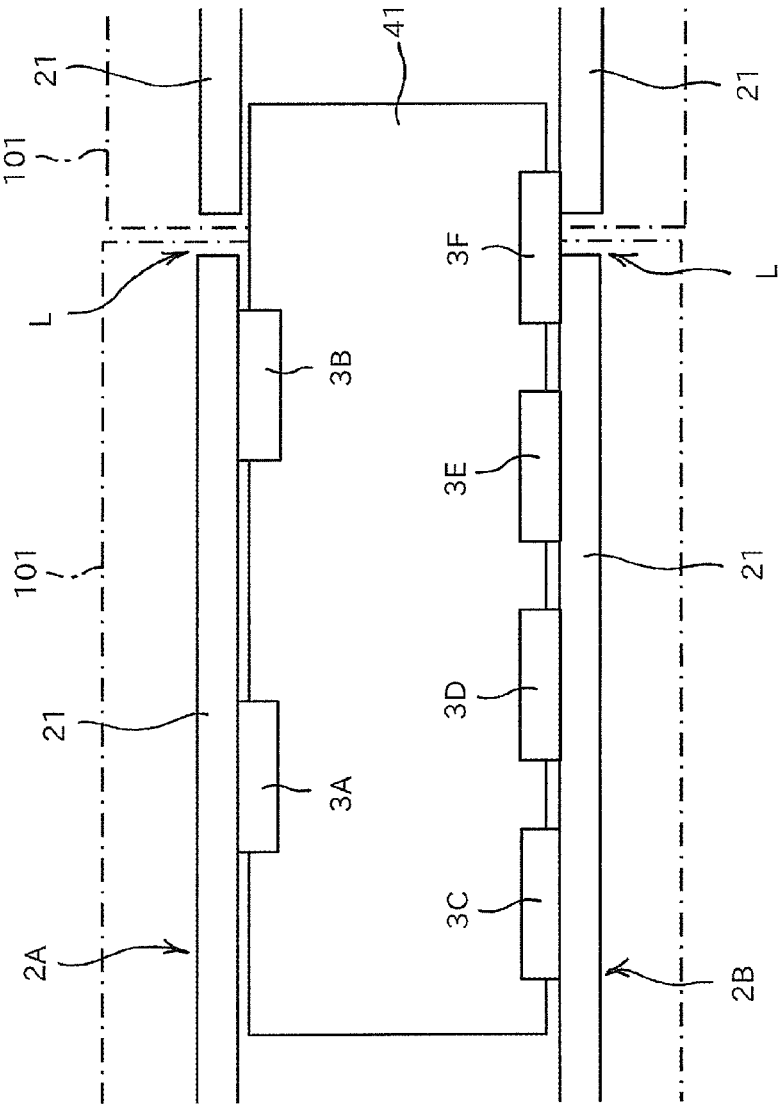


Fig. 6

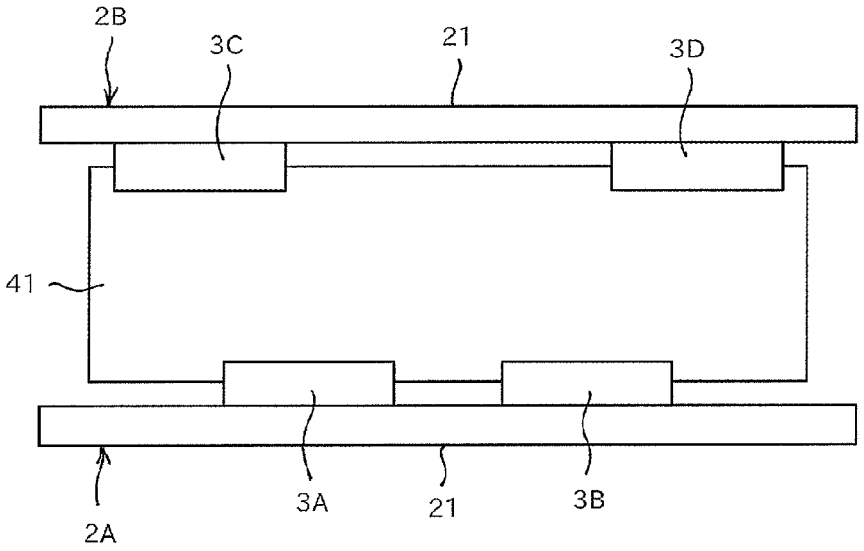


Fig. 7

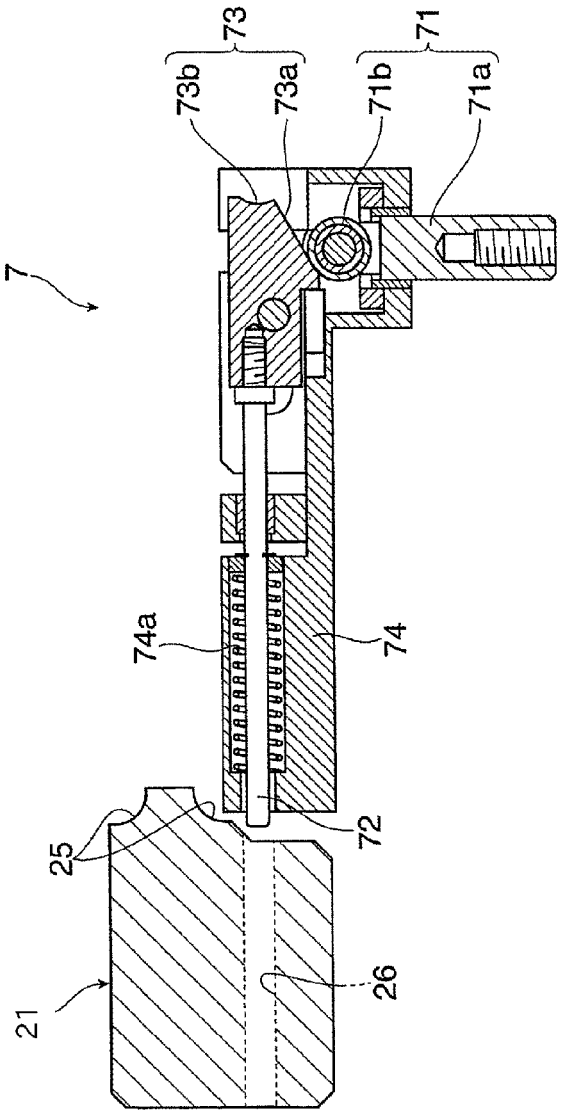


Fig. 8

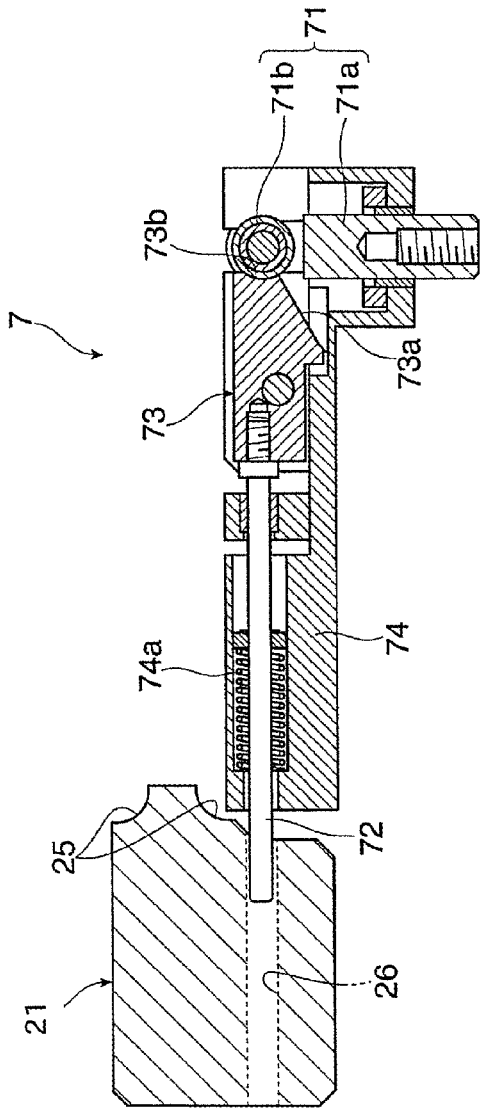
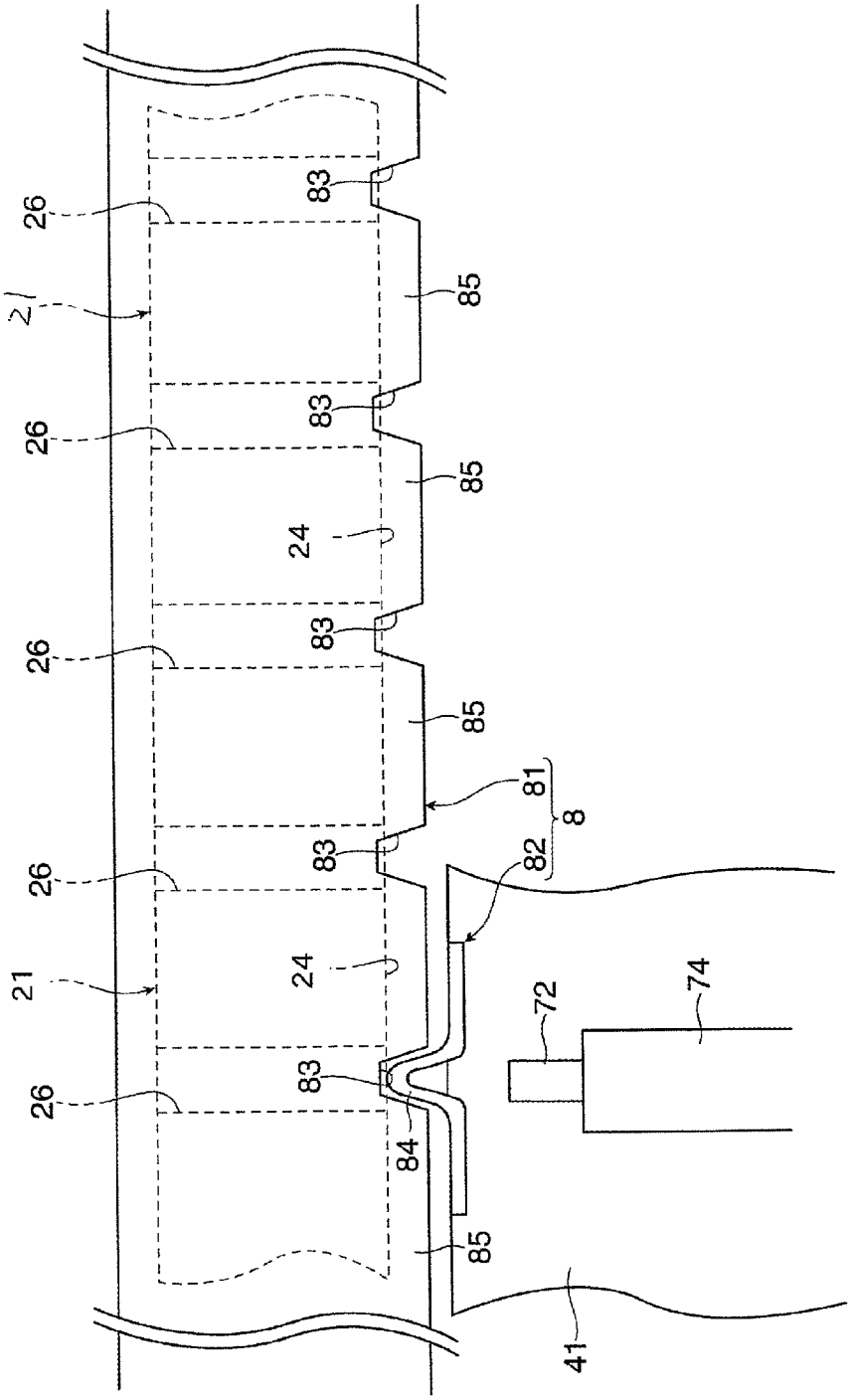


Fig. 9



MOVEMENT UNIT

TECHNICAL FIELD

The present invention relates to a moving unit for freely guiding a movable body such as various units and tables along a pair of guide tracks laid on a fixed portion in parallel to each other.

BACKGROUND ART

Hitherto, the moving unit of this type has been disclosed in WO 2005/031082. This moving unit disclosed in NO 2005/031082 is used for freely moving furniture items, electric appliances, and the like on a wall surface of buildings. This moving unit includes a pair of track rails being laid on the wall surface in parallel to each other and each having rolling surfaces for rolling elements, which are formed along a longitudinal direction of the track rails, a plurality of moving blocks assembled to the track rails through intermediation of a large number of the rolling elements that roll on the rolling surfaces of the track rails, and a movable body fixed to the moving blocks and guided along the track rails on the wall surface. Examples of the movable body may include a base plate for fixing electric appliances such as a television or furniture items, and casings themselves of the electric appliances. This moving unit enables such movable bodies to be freely moved on the wall surface.

Further, the moving unit of this type may be used to, for example, move various devices, interior equipment, and the like in a large space such as passenger cabins in aircrafts, ships, or trains so that those devices and interior equipment are arranged at arbitrary positions in the space. Specifically, in a passenger cabin of an aircraft, service units are provided correspondingly to respective seats. Those service units each contain emergency supplies such as an oxygen mask, and devices such as a seat number indication and a reading light are mounted to the service units. When those service units can be moved along a ceiling surface in the passenger cabin and fixed at arbitrary positions, an array pitch of the seats in the passenger cabin can be changed significantly easily.

In this case, in order to move the service units over the entire length of the passenger cabin of the aircraft, a plurality of track rails need to be arranged in series so as to form long guide tracks, to thereby move the moving blocks along the guide tracks while passing from one track rail to another.

CITATION LIST

Patent Literature

[PTL 1] WO 2005/031082 A1

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

In this context, large structures such as the aircraft and the ship are often manufactured by preparing a plurality of segments and lastly coupling those segments to each other, to thereby complete an intended large structure. In this case, in consideration of simplification of final assembly of the structure, it is inappropriate to fix the track rails while bridging over a coupling portion of the adjacent segments. Further, in the case of airliners, extensive interior furnishing of the passenger cabin is difficult to perform after completion of assembly of a fuselage. Thus, at the time of assembly of the fuselage, a plurality of fuselage segments are not welded to each other until a part of the interior furnishing, which is performed on each of the fuselage segments prior to the assembly of the fuselage, is progressed to some extent. Under the circumstances, in order to form long guide tracks in the large structure, it is appropriate to first fix the track rails to the segments, and then couple the segments to which the track rails are fixed, to thereby complete the long guide tracks in the large structure.

Thus, in consideration of the coupling of the segments, clearances need to be secured in advance between end portions of the track rails that are opposed to each other across the coupling portions. Further, in the case of the large structures such as the aircraft, the train, and the ship, there is a risk in that the segments thereof are deformed differently from each other when an external force is applied to those structures. When the plurality of track rails of the guide tracks are arrayed without securing the clearances between the end portions, there is another risk in that the end portions of the adjacent track rails significantly interfere with each other. Thus, also from such viewpoints, clearances may need to be secured in advance at joints between the adjacent track rails. Dimensions of the clearances, which are differently set depending on a size of a structure in which the track rails are laid, may be set to approximately ten and several millimeters. Those dimensions are clearly larger than a diameter of each of the rolling elements provided to the above-mentioned moving blocks.

In this way, in a case where the clearances are formed at the joints between the track rails of the above-mentioned guide tracks, when the moving blocks reach the joints between the track rails, the rolling elements fail to come into contact with the rolling surfaces of the track rails, and are brought into a non-load state. In this state, the moving blocks cannot bear loads of the rolling elements, and may be significantly displaced with respect to the track rails. As a result, the movable body supported by the moving blocks may be hindered from being smoothly moved.

Note that, the moving unit disclosed in Patent Literature 1 is described as an example of the devices for guiding the movable body to an arbitrary position along a given path, but the problems described above may occur also in moving units of such a type that the moving blocks including low-friction sliding contact members slide on the track rails, or such a type that the moving blocks including pivotally supported wheels travel on the track rails while rotating the wheels.

Means for Solving the Problems

The present invention has been made to solve the problems described above, and it is an object thereof to provide a moving unit that enables moving blocks to be smoothly moved along guide tracks for guiding a movable body across joints between a plurality of track rails arranged in series so as to serve as the guide tracks, to thereby enable the movable body to be smoothly moved with respect to a fixed portion.

Specifically, according to one embodiment of the present invention, there is provided a moving unit, including: a pair of guide tracks laid on a fixed portion in parallel to each other; a plurality of moving blocks including at least two moving blocks assembled to each of the pair of guide tracks, the plurality of moving blocks being freely movable along the pair of guide tracks; and a movable body fixed to the plurality of moving blocks and freely movable on the fixed portion. The pair of guide tracks includes a plurality of track rails each having a guide surface formed along a longitudinal direction of each of the plurality of track rails, and being arranged in

series with their end portions connected to each other, whereas the plurality of moving blocks each include contact elements configured to travel on the guide surface while passing across joint clearances each being formed between the plurality of track rails arranged in series. Further, when one of the plurality of moving blocks is positioned at any one of the joint clearances each being formed between the plurality of track rails of the pair of guide tracks, another of the plurality of moving blocks is prevented from being positioned at another of the joint clearances.

Effects of the Invention

According to one embodiment of the present invention, under a state in which one of the plurality of moving members assembled to each of the pair of guide tracks is positioned at the joint clearance formed between the track rails arranged in series, the other of the moving members assembled to each of the guide tracks is not positioned at the joint clearance formed on the track rails. Thus, in a case where the movable body is moved along the guide tracks, at least three of the moving blocks are not positioned at the joint clearance formed on the track rails, but bear a load to be applied to the movable body. In this state, the movable body supported by those moving blocks can reciprocate in a stable posture along the guide tracks while passing across joints between the track rails.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic view of an application example of a moving unit according to the present invention.

FIG. **2** is a perspective view of an example of the moving unit according to an embodiment to which the present invention is applied.

FIG. **3** is an enlarged perspective view of a main part of the moving unit to which the present invention is applied.

FIG. **4** is a perspective view of a combination of a moving block and a track rail that can be used in the moving unit of the present invention.

FIG. **5** is a schematic view illustrating an arrangement relationship between joint clearances on guide tracks and the moving blocks for a movable body.

FIG. **6** is a schematic view of another example of an arrangement of the moving blocks on the moveable body.

FIG. **7** is a sectional side view of an example of a position fixing member for the movable body.

FIG. **8** is a sectional side view of an operating state of the position fixing member illustrated in FIG. **7**.

FIG. **9** is a schematic view of position detecting means of the movable body with respect to the guide track.

MODE FOR CARRYING OUT THE INVENTION

Now, with reference to the accompanying drawings, detailed description is made of a moving unit according to an embodiment of the present invention.

FIG. **1** illustrates an example of how the moving unit according to the embodiment of the present invention is used. For example, in a passenger cabin **100** of an aircraft, service units **42** are arranged on a ceiling panel **101** of the passenger cabin **100** correspondingly to seats **102** for passengers. Those service units **42** each contain emergency supplies such as an oxygen mask, and include various indication devices mounted thereto, such as a seat number indication and a reading light. In general, an array interval of the seats **102** in the passenger cabin **100** of an aircraft is different from airline to airline that operates the aircrafts. Thus, aircraft manufacturers customize the array of the seats **102** in the passenger cabin **100** in accordance with requests from airlines. In view of the circumstances, from a viewpoint of the aircraft manufacturers, when the arrangement of the service units **42** can be freely customized in accordance with the array interval of the seats **102**, and when the service units **42** can be freely removed from the ceiling of the passenger cabin **100** in accordance with an increase or decrease in number of the seats, convenience of assembly of aircrafts can be enhanced. Further, the service units **42** contain the emergency supplies, and hence regular maintenance inspection needs to be performed on the service units **42** themselves. Also from this viewpoint, when the service units **42** can be freely removed, convenience of the airlines that operate aircrafts is enhanced.

The moving unit according to the present invention satisfies such demands. Specifically, the service units **42** are arranged in a freely movable manner on the ceiling panel **101** as a fixed portion, and the service units **42** can be fixed at arbitrary positions on the ceiling panel **101**. In addition, the service units **42** can be freely removed from the ceiling panel **101** as the fixed portion.

FIGS. **2** and **3** illustrate an example of a moving unit **1** according to the embodiment to which the present invention is applied. FIG. **2** is a perspective view of a state in which the moving unit **1** is used so that the service unit **42** is supported by the ceiling panel **101** as the fixed portion. FIG. **3** is a perspective view of a main part of the moving unit **1** without the ceiling panel **101**.

The moving unit **1** includes a pair of guide tracks **2** laid in parallel to each other on the ceiling panel **101** as the fixed portion in the passenger cabin **100** of an aircraft, a plurality of moving blocks **3** assembled to each of the guide tracks **2**, and a movable body **41** to which those moving blocks **3** are fixed. The guide tracks **2** each include a plurality of linear track rails **21** laid in series. When the number of track rails **21** to be laid in series is increased, the long guide tracks **2** can be formed in accordance with the entire length of the ceiling panel **101**. Further, in order to form the guide tracks **2** to be even longer, a plurality of ceiling panels **101** may be arranged in series. The track rails **21** each have a guide surface **25** for guiding the moving blocks **3** along its longitudinal direction. With this, in a case where the plurality of track rails **21** are laid in series, the guide surfaces **25** of the track rails **21** are continuously aligned with each other. In this way, a single guide surface is formed over the entire length of each of the guide tracks **2**.

In the example illustrated in FIG. **3**, the pair of guide tracks **2** is arranged so that the guide surfaces **25** thereof are opposed to each other, and the moving blocks **3** fixed to the movable body **41** are assembled outward from an inside of the pair of the guide tracks **2**. The moving blocks **3** each include contact elements to travel on the guide surfaces **25** of the track rails **21**. Those contact elements function to enable the moving blocks **3** to freely move along the track rails **21** while bearing a load that is applied to the movable body **41**. Then, under a state in which the moving blocks **3** are assembled to each of the guide tracks **2**, the movable body **41** is prevented from dropping off from a position between the pair of guide tracks **2**. Further, the moving blocks **3** are enabled to freely move over the entire length of the guide tracks **2** while sequentially passing across the plurality of track rails **21** laid in series.

In this way, the movable body **41** fixed to the moving blocks **3** can be freely moved along the guide tracks **2**. In addition, when the service units **42** are fixed to the movable body **41**, the service units **42** can be freely moved to arbitrary positions on the long ceiling panel **101**. The movable body **41** is made of a metal material or a resin material.

Note that, in the example illustrated in FIGS. **2** and **3**, the moving blocks **3** are fixed to the plate-like movable body **41** and the service unit **42** is fixed to this movable body **41**. However, as a matter of course, the movable body **41** may be formed integrally with the service unit **42** and the moving blocks **3** may be fixed to the service unit **42** itself. Further, in the example illustrated in FIGS. **2** and **3**, the moving blocks **3** of the present invention are applied to the service unit **42** in the passenger cabin **100** of an aircraft. However, an object to be fixed to the movable body **41** is not limited to the service unit **42**. Further, in the following description, the ceiling panel **101** is used as the fixed portion to which the track rails **21** are laid. However, an object to which the track rails **21** are laid is not limited thereto, and as a matter of course, the object to which the track rails **21** are laid may include a wall surface, a floor, or other machinery equipment.

FIG. **4** is a perspective view of an example of a combination of the track rail **21** and the moving block **3**. In the example illustrated in FIG. **4**, the track rail **21** is formed into a substantially rectangular shape in cross-section perpendicular to the longitudinal direction thereof. Mounting holes **22** for fixing bolts are formed through the track rail **21** at predetermined intervals along the longitudinal direction. Those mounting holes **22** are used at the time when the track rail **21** is laid on the ceiling panel **101** as the fixed portion.

Further, on one side surface of the track rail **21**, a projection portion **23** is formed along the longitudinal direction. On upper and lower sides with respect to this projection portion **23**, a pair of rolling surfaces **24** for balls **31** is formed as the guide surface **25**. Those ball rolling surfaces **24** are each inclined at an angle of 45° with respect to a bottom surface of the track rail **21**, and the balls **31** roll on the pair of rolling surfaces **24** while sandwiching the projection portion **23**.

Still further, a plurality of fixing holes **26** are formed through the track rail **21** at predetermined intervals in the longitudinal direction. Those fixing holes **26** are positioned between the projection portion **23** and the bottom surface of the track rail **21**, and formed through side surfaces of the track rail **21**. As described later, those fixing holes **26** are used at the time when the moving blocks **3** are fixed at arbitrary positions on the track rail **21**.

Meanwhile, the moving block **3** include a large number of the balls **31** serving as the contact elements, and those balls **31** roll on the rolling surfaces **24** of the track rail **21**. With this, the moving block **3** can be freely moved along the track rail **21**. In the moving block **3**, load-rolling surfaces **32** are formed in two rows so as to be opposed to the rolling surfaces **24** of the track rail **21**. When the rolling surfaces **24** and the load-rolling surfaces **32** are opposed to each other, load ball paths are formed therebetween, through which the balls **31** roll while bearing a load between the track rail **21** and the moving block **3**.

Further, the moving block **3** has endless circulation paths **33** in two systems for the balls **31** correspondingly to the load-rolling surfaces **32** in two rows. The endless circulation paths **33** couple both ends of the load ball paths, and each have an inner diameter set to be slightly larger than a diameter of each of the balls **31**. Thus, after rolling on the load-rolling surfaces **32**, the balls **31** roll on the endless circulation paths **33** under a non-load state, and then are returned onto the load-rolling surfaces **32**. In other words, the balls repeatedly roll on the load ball paths through the endless circulation paths **33** so as to enable the moving block **3** to move over the entire region in the longitudinal direction of the track rail **21**. Note that, in FIG. **4**, for the sake of better understanding of how the balls **31** circulate in the moving block **3**, half of the moving block **3** is not illustrated, and the balls **31** illustrated therein are those only in one of the two systems.

Still further, a retaining plate **34** is mounted to the moving block **3**, and the retaining plate **34** is positioned between the moving block **3** and the track rail **21**. The retaining plate **34** has a pair of opening portions formed so as to be opposed to the pair of rolling surfaces **24** formed on the track rail **21**. Spherical surfaces of the balls **31** to roll on the load-rolling surfaces **32** of the moving block **3** are partially exposed from those opening portions and exposed parts of the spherical surfaces are held in contact with the rolling surfaces **24** of the track rail **21**. A width of each of the opening portions is set to be smaller than the diameter of each of the balls **31**. Even in a case where the moving block **3** is separated from the track rail **21**, the balls **31** do not drop off from the moving block **3**.

As described above, the guide tracks **2** are each formed by laying the plurality of track rails **21** in series. For example, in FIG. **2**, the pair of guide tracks **2** is formed on the ceiling panel **101** as the fixed portion, and the guide tracks **2** are each formed of two track rails **21** laid in series. In this case, the two track rails **21** of each of the guide tracks **2** are laid on the single ceiling panel **101**. Thus, no clearances need to be secured between connecting portions, that is, at joints between those track rails **21**, and the two track rails **21** are laid on the ceiling panel **101** under a state in which the end portions thereof are held in contact with each other.

However, in a case where the long guide tracks **2** are formed by arranging the plurality of ceiling panels **101** in series after laying the track rails **21** on each of the ceiling panels **101**, as illustrated in FIG. **5**, there is a risk in that gaps are formed between the end portions of the track rails **21** at joints between the ceiling panels **101**. Further, in consideration of a risk of deformation of each of the ceiling panels **101**, in order to avoid interference between the end portions of each of the track rails **21** at the joints between the ceiling panels **101**, clearances L may need to be intentionally secured between the end portions of each of the track rails **21** (hereinafter referred to as "joint clearances L").

In a case where the movable body **41** needs to be moved over the entire length of the guide tracks **2** while passing across the joints between the ceiling panels **101**, the moving blocks **3** fixed to the movable body **41** also pass across the joint clearances L between the track rails **21**. However, dimensions of the joint clearances L reach approximately ten and several millimeters, which is larger in most cases than the diameter of each of the balls **31** serving as the contact elements provided in each of the moving blocks **3**. Thus, when the moving blocks **3** come closer to the joint clearances L, there arises a risk in that the balls **31** are not held in contact with the rolling surfaces **24** of the track rails **21**, and the moving blocks **3** cannot bear the load to be applied to the movable body **41**. As a result, a posture of the movable body **41** may be unstable.

As a countermeasure, at the time of fixing of the moving blocks **3** to the movable body **41**, arrangement of the moving blocks **3** on the movable body **41** is determined so that two or more of the moving blocks **3** do not simultaneously come to positions of the joint clearances L between the track rails **21**. In the example illustrated in FIG. **5**, six moving blocks **3**A to **3**F are fixed to the movable body **41**, specifically, assembled to any one of the guide tracks **2**A and **2**B in two rows. More specifically, two moving blocks **3**A and **3**B are assembled to the guide track **2**A, and four moving blocks **3**C to **3**F are assembled to the guide track **2**B. Further, an array interval between the two moving blocks **3**A and **3**B assembled to the guide track **2**A is different from an array interval between the four moving blocks **3**C to **3**F assembled to the guide track **2**B.

The moving blocks **3**A and **3**B on the guide track **2**A side are provided at position displaced from any one of the moving blocks **3**C to **3**F on the guide track **2**B side. Specifically, in longitudinal directions of the guide tracks **2**A and **2**B, the moving blocks **3**A and **3**B on the guide track **2**A side and the moving blocks **3**C to **3**F on the guide track **2**B side are fixed out of phase with each other to the movable body **41**. More specifically, in the example illustrated in FIG. **5**, the moving block **3**A on the guide track **2**A side and the moving blocks **3**C and **3**D on the guide track **2**B side are positioned in a triangular arrangement on the movable body **41**, and the moving block **3**B on the guide track **2**A side and the moving blocks **3**E and **3**F on the guide track **2**B side are positioned in a triangular arrangement on the movable body **41**. Further, a length of each of the track rails **21** of the guide tracks **2**A and **2**B is set to be larger than the distance between the moving block **3**C and the moving block **3**D.

Thus, for example, when the moving block **3**F on the guide track **2**B side passes across the joint clearance L on the guide track **2**B, the moving block **3**B on the guide track **2**A side has not yet reached the joint clearance L on the guide track **2**A. Of the six moving blocks **3** fixed to the movable body **41**, only the moving block **3**F is positioned at the joint clearance. Meanwhile, when the moving block **3**B on the guide track **2**A side passes across the joint clearance L on the guide track **2**A, the moving block **3**F on the guide track **2**B side has already passed across the joint clearance L, and the moving block **3**E has not yet reached the joint clearance L. In other words, even when one of the six moving blocks fixed to the movable body is positioned at the joint clearance L on the guide track **2**A or **2**B, the other five moving blocks are assembled to the track rails **21** without reaching the joint clearances L.

Thus, even in a case where one of the moving blocks **3** is brought into a load unbearable state at the joint clearance L at the time when the movable body **41** passes across the joint clearance L, the other moving blocks **3** are assembled to the track rails **21** without being positioned at the joint clearances L. Thus, those moving blocks **3** can reliably bear the load to be applied to the movable body **41**. With this, the movable body **41** can be stably moved over the entire length of the long guide tracks **2**A and **2**B.

The number of the moving blocks **3** to be fixed to the movable body **41** is not limited to six as long as two or more moving blocks are assembled to each of the guide tracks **2**A and **2**B. FIG. **6** illustrates an example in which four moving blocks **3**A to **3**D are fixed to the movable body **41**. In this way, also in a case where the four moving blocks **3**A to **3**D are used, an array interval between the two moving blocks **3**A and **3**B assembled to the guide track **2**A is different from an array interval between the two moving blocks **3**C and **3**D assembled to the guide track **2**B. In other words, the moving blocks **3**A and **3**B on the guide track **2**A side are fixed to the movable body **41** out of phase with the moving blocks **3**C and **3**D on the guide track **2**B side.

Thus, even when the moving block **3**D reaches the joint clearance L on the guide track **2**B, the other moving blocks **3**A to **3**C are assembled to the track rails **21** without overlapping with the joint clearances. Thus, three moving blocks **3**A to **3**C can bear the load to be applied to the movable body **41**. With this, the movable body **41** can be stably moved over the entire length of the guide tracks **2**A and **2**B.

In the examples illustrated in FIGS. **5** and **6**, the array interval between the plurality of moving blocks **3** assembled to the guide track **2**A on one side and the array interval between the plurality of moving blocks **3** assembled to the guide track **2**B on another side are different from each other. With this, the plurality of the moving blocks **3** may avoid simultaneously coming to the positions of the joint clearances L. Alternatively, in order that the plurality of moving blocks **3** may avoid simultaneously coming to the positions of the joint clearances L, positions of the joint clearance L on the guide track **2**A and positions of the joint clearance L on the guide track **2**B may be intentionally displaced from each other.

Further, although not clearly illustrated in FIG. **4**, ball leading surfaces are formed at both ends in a longitudinal direction of each of the rolling surfaces **24** of the track rails **21**. Those ball leading surfaces are formed by performing a crowning process on end portions of the rolling surfaces **24**. In regions in which the ball leading surfaces are formed, an interval between the moving block **3** and the rolling surface **24** becomes gradually larger toward the end portions of the track rails **21**. Those ball leading surfaces are formed so as to enable the moving blocks **3** to smoothly pass across the joint clearances L. In a case where those ball leading surfaces are formed, when the moving blocks **3** pass across the joint clearances L, loads to be applied to the balls **31** interposed between the moving blocks **3** and the track rails **21** are gradually reduced, and then gradually increased. Note that, those ball leading surfaces may be arbitrarily formed on the rolling surfaces **24** of the track rails **21**. Even in a case where those ball leading surfaces are not formed, the moving blocks **3** can pass across the joint clearances L.

The moving block of the present invention is not limited to the moving block illustrated in FIG. **4**, specifically, a moving block of such a type that the endless circulation paths for the balls are formed and the balls roll on the rolling surfaces **24** of the track rails **21**. For example, the moving block of the present invention may be a moving block of such a type that the moving blocks including low-friction sliding contact members slide on the track rails, or such a type that the moving blocks including pivotally supported wheels travel on the track rails while rotating the wheels.

Next, description is made of a position fixing member for fixing the movable body **41** at particular positions on the guide tracks **2**A and **2**B.

As described above, the movable body **41** can be freely moved to arbitrary positions on the guide tracks **2**A and **2**B. However, it is conceived that, in many situations of practical use of the movable body **41**, the movable body **41** is not used while being moved with respect to the guide tracks **2**A and **2**B, but the movable body **41** is used while being fixed at the particular positions on the guide tracks **2**A and **2**B as described above by way of the example of the use in the passenger cabin **100** of an aircraft. Thus, the position fixing member may be provided to the movable body **41**. This position fixing member is configured to restrict moving of the movable body **41** by using the fixing holes **26** formed at predetermined intervals along the track rails **21**. An operator can fix the movable body **41** at arbitrary positions corresponding to the fixing holes **26** by moving the movable body **41** to particular positions on the guide tracks **2**A and **2**B, and then operating this position fixing member.

FIGS. **7** and **8** are sectional side views of an embodiment of the position fixing member as viewed in the longitudinal direction of the track rails **21**. FIG. **7** illustrates an initial state of the position fixing member, and FIG. **8** illustrates an operating state of the position fixing member. This position fixing member **7** includes an engaging pin **72** to be inserted into and retracted from the fixing holes **26** formed through the track rails **21**, a setting pin **71** for switching the position fixing member **7** between the initial state and the operating state, a driven plate **73** for transmitting moving of the setting pin **71** to the engaging pin **72**, and a housing **74** for housing the setting

pin **71**, the engaging pin **72**, and the driven plate **73**. The housing **74** is fixed to the movable body **41**.

The setting pin **71** includes a shank portion **71***a* provided orthogonally to the engaging pin **72** and projecting from the housing **74**, and a cam portion **71***b* provided in a freely rotatable manner at one end of the shank portion **71***a*. The shank portion **71***a* projects from the movable body **41** to an opposite side with respect to the ceiling panel **101**, and a female thread is provided at a distal end thereof so that other members for pushing or pulling the shank portion **71***a* in an axial direction can be coupled thereto. Further, the setting pin **71** is held by the housing **74** so that the setting pin **71** can be freely moved in the axial direction of the shank portion **71***a*. Thus, a distal end of the setting pin **71** projects into, for example, the service units **42** illustrated in FIGS. **2** and **3** so that the setting pin can be operated from the service unit **42** side.

Meanwhile, the driven plate **73** is a member for converting the moving in the axial direction of the setting pin to a moving in a direction orthogonal thereto, and has an inclined portion **73***a* to come into sliding contact with an outer peripheral surface of the cam portion **71***b* of the setting pin **71**, and a retaining portion **73***b* that is formed into a concave shape having substantially the same curvature as that of the outer peripheral surface of the cam portion **71** band is continuous with the inclined portion **73***a*. Further, the engaging pin **72** is a columnar member substantially coaxial with those of the fixing holes **26** of the track rails **21** and retained in the housing **74** so as to be freely movable in its axial direction. This engaging pin **72** is always urged by a coil spring **74***a* provided in the housing **74** into a direction away from the track rails **21**. Further, a rear end of the engaging pin **72** is fixed to the driven plate **73**, and the engaging pin **72** is inserted into and retracted from the fixing holes **26** of the track rails **21** in conjunction with moving of the driven plate **73**.

In the initial state illustrated in FIG. **7**, the engaging pin **72** is retracted from the fixing hole **26** of the track rail **21** by an action of the coil spring **74***a*. In this state, the position fixing member **7** is inactive at all, and hence the movable body **41** can be freely moved along the longitudinal direction of the track rails. At this time, the cam portion **71***b* of the setting pin **71** is held in contact with the inclined portion **73***a* of the driven plate **73**.

In this initial state, when the setting pin **71** is pressed in the axial direction so that the setting pin **71** is pushed into the housing **74**, the cam portion **71***b* rolls along the inclined portion **73***a* of the driven plate **73** to cause the driven plate **73** to be moved together with the engaging pin **72** against an elastic force of the coil spring **74***a*. In this way, a distal end of the engaging pin **72** is inserted into the fixing hole **26** of the track rail **21**. Then, as illustrated in FIG. **8**, under a state in which the setting pin **71** is fully pushed into the housing **74**, the cam portion **71***b* rolls from the inclined portion **73***a* of the driven plate **73** onto the concave retaining portion **73***b* thereof. With this, the engaging pin **72** is moved out by a maximum amount with respect to the fixing hole **26** of the track rail **21**. Further, in this state, the concave retaining portion **73***b* of the driven plate **73** is pressed against the cam portion **71***b* of the setting pin **71** by the elastic force pf the compressed coil spring **74***a*. Unless the shank portion **71***a* of the setting pin **71** is intentionally pulled back, the cam portion **71***b* is not separated from the retaining portion **73***b* of the driven plate **73**, or the engaging pin **72** is not retracted from the fixing hole **26** of the track rail **21**.

Thus, when the movable body **41** is moved to an arbitrary position along the guide tracks **2**A and **2**B, and the setting pin **71** is pushed at this position in the axial direction, the engaging pin **72** is inserted into the fixing hole **26** of the track rail **21**. In this way, the movable body **41** is fixed at this position. Further, when the setting pin **71** is pulled back, the cam portion **71***b* is separated from the retaining portion **73***b* of the driven plate **73**. In conjunction therewith, the engaging pin **72** is pulled back and retracted from the fixing hole **26** of the track rail. In this way, the movable body **41** can be moved along the guide tracks **2**A and **2**B again.

Meanwhile, the fixing holes **26** are formed at predetermined intervals through the track rails **21**. Thus, even in a case where the movable body **41** is moved to an arbitrary position on the guide tracks **2**A and **2**B, it is uncertain whether or not the engaging pin **72** of the above-mentioned position fixing member **7** can be reliably inserted into the fixing hole **26** of the track rail **21** at that position. Thus, at the time of using the position fixing member **7**, the operator needs to find a matching position between the engaging pin **72** and the fixing hole **26** by slightly moving the movable body **41** forward and rearward. As means for avoiding such troublesome operations, it is appropriate to introduce a position detecting member for accurately matching stop positions of the movable body **41** with the fixing holes **26** of the track rail **21**.

FIG. **9** illustrates an example of the position detecting member. This position detecting member **8** includes a reference plate **81** that is fixed to the ceiling panel **101** together with the track rails **21**, and an elastic plate **82** that is fixed to the movable body **41** and moved along the guide tracks **2**A and **2**B together with the movable body **41**.

The reference plate **81** is a long plate-like member provided along the longitudinal direction of the track rails **21**, and has a plurality of engaging grooves **83** formed at equal intervals along the longitudinal direction. The engaging grooves **83** are formed at the same intervals as those of the fixing holes **26** of the track rails **21**. The reference plate **81** is laid on the ceiling panel **101** together with the track rails **21** so that formation positions of the engaging grooves **83** and formation positions of the fixing holes **26** overlap with each other.

Meanwhile, the elastic plate **82** is formed by bending a thin plate, and has an engaging projection **84** to be fitted into the engaging grooves **83** of the reference plate **81**. This elastic plate **82** is fixed to the movable body **41**, and adjusted in fixing position so that a distal end of the engaging projection **84** enter the engaging grooves **83** of the reference plate **81**, and that the engaging projection **84** overlaps with the engaging pin **72** of the position fixing member **7**. The elastic plate **82** is formed by bending a thin plate, and hence is easily deformed. When the movable body **41** is moved under a state in which the engaging projection **84** is inserted in the engaging groove **83** of the reference plate **81**, the engaging projection **84** is moved out of one of the engaging grooves **83**, climbs onto a land portion **85** between the engaging grooves **83**, and then re-enters subsequent one of the engaging grooves **83**.

Thus, along with the moving of the movable body **41** along the longitudinal direction of the track rails **21**, the engaging projection **84** of the elastic plate **82** is repeatedly moved into and out of the engaging grooves **83** of the reference plate **81** while being moved along the reference plate **81**. With this, the operator who moves the movable body **41** can easily feel whether or not the engaging projection **84** is engaged with the engaging groove **83**. Further, under a state in which the engaging projection **84** is engaged with the engaging groove **83**, the engaging pin **72** of the position fixing member **7** is opposed to the fixing hole **26** of the track rail **21**. Thus, the operator can easily insert the engaging pin **72** into the fixing hole **26** of the track rail **21** by operating the setting pin **71** of the position fixing member **7**. In other words, at the time of moving the movable body **41** along the guide tracks **2**A and

2B and fixing the movable body **41** to predetermined positions, the operator can easily recognize positions of the fixing holes **26** of the track rails **21**. Thus, the operator can easily perform a fixing operation of the movable body **41** by using the position fixing member **7** described above.

The invention claimed is:

1. A moving unit, comprising:

a pair of guide tracks laid on a fixed portion in parallel to each other;

a plurality of moving blocks comprising at least two moving blocks assembled to each of the pair of guide tracks, the plurality of moving blocks being freely movable along the pair of guide tracks; and

a movable body fixed to the plurality of moving blocks and freely movable on the fixed portion,

wherein the pair of guide tracks comprises a plurality of track rails each having a guide surface formed along a longitudinal direction of each of the plurality of track rails, and being arranged in series with their end portions connected to each other,

wherein the plurality of moving blocks each comprise contact elements configured to travel on the guide surface while passing across joint clearances each being formed between the plurality of track rails arranged in series, and

wherein, when one of the plurality of moving blocks is positioned at any one of the plurality of joint clearances formed on the pair of guide tracks, another of the plurality of moving blocks is prevented from being positioned at another of the plurality of joint clearances.

2. The moving unit according to claim **1**, wherein the plurality of joint clearances each being formed between the plurality of track rails each comprise a clearance larger than a diameter of each of the contact elements.

3. The moving unit according to claim **1**,

wherein the plurality of track rails each have a plurality of fixing holes arrayed at predetermined intervals along the longitudinal direction of the each of the plurality of track rails, and

wherein the movable body comprises a position fixing member for restricting moving of the movable body with respect to the pair of guide tracks, the position fixing member comprising an engaging pin freely insertable into and retractable from any one of the plurality of fixing holes of the plurality of track rails.

4. The moving unit according to claim **2**,

wherein the plurality of track rails each have a plurality of fixing holes arrayed at predetermined intervals along the longitudinal direction of the each of the plurality of track rails, and

wherein the movable body comprises a position fixing member for restricting moving of the movable body with respect to the pair of guide tracks, the position fixing member comprising an engaging pin freely insertable into and retractable from any one of the plurality of fixing holes of the plurality of track rails.

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